

MASTER OF SCIENCE IN MATERIALS SCIENCE AND ENGINEERING

PRODUCTION OF ULTRA-FINE GRAINS AND EVOLUTION OF GRAIN BOUNDARIES DURING SEVERE PLASTIC DEFORMATION OF ALUMINUM AND ITS ALLOYS

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Master of Science in Materials Science and Engineering-December 2000

Mechanical Engineer-December 2000

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Equal channel-angular pressing (ECAP) is a recently developed method for deformation processing of material that can produce an ultra-fine grain structure in bulk material through severe plastic deformation. This study will present results on microstructural evolution during repetitive ECAP of pure aluminum. The principal method of data collection was Orientation Imaging Microscopy (OIM). The results of the study indicate that, after one ECAP pass, the structure is inhomogeneous and anisotropic, and consists mostly of deformation-induced features. After repetitive ECAP, the aluminum material exhibited a homogeneous grain size but retained an anisotropic character to the microstructure. After twelve ECAP passes the microstructure consisted mainly of fine grains surrounded by high-angle boundaries but an appreciable fraction of low-angle boundaries remained. This microstructure thus comprises a mixture of deformation-induced and recrystallization features. Further results were also obtained documenting the existence of deformation banding in this material as well as in a rolled aluminum alloy. This phenomenon may be general in nature and associated with severe plastic deformation in aluminum and its alloys.

DoD KEY TECHNOLOGY AREAS: Materials, Processes, and Structures, Manufacturing Science and Technology (MS&T)

KEYWORDS: Equal Channel-Angular Pressing, Ultra-fine Grains, Grain Refinement, Plastic Deformation, Deformation Banding, Misorientation Angle, Orientation Imaging Microscopy, Electron Backscatter Diffraction, Supral 2004, Nano Structures, Severe Plastic Deformation